

Consortium for Electric Reliability Technology Solutions

PIER Energy System Integration Transmission R&D Scenario Analysis Project

Presentation of Project Findings from the Draft Report

CEC PIER Transmission R&D Workshop
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Joe Eto, Lawrence Berkeley National Laboratory
John Stovall, Oak Ridge National Laboratory

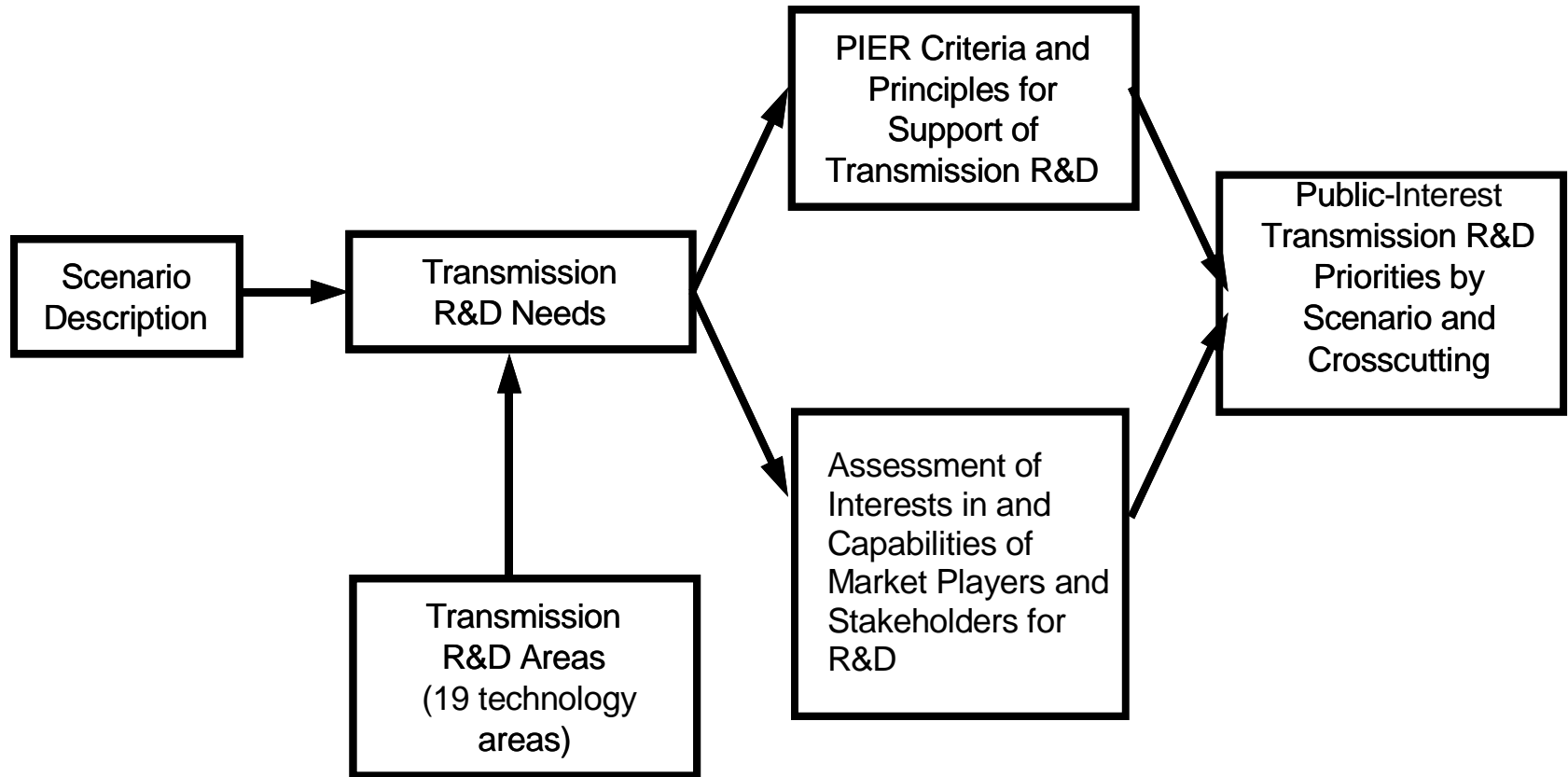
Objectives for Today's Presentation

- Present project findings from the *draft* report
 - Review project background and approach
 - List transmission technologies
 - Summarize PIER's criteria and considerations for R&D
 - Describe four scenarios
 - Apply PIER criteria to assess R&D interests/capabilities
 - Identify public interest transmission R&D priorities
- Obtain input from workshop participants
 - Five workshop questions will initiate these discussions

Project Background

- As one task of the PIER/ESI Electric Systems Reliability project, CERTS has been supporting PIER/ESI R&D planning
 - CERTS is also tasked to conduct research on real grid reliability management; demand response, and DER integration for PIER
- In 2000, CERTS conducted a scenario analysis on priorities for federal electricity reliability R&D for U.S. DOE Transmission Reliability Program
 - Prepared six Grid of the Future white papers – <http://certs/lbl.gov>
- PIER ESI tasked CERTS to develop and analyze CA-specific scenario as one input to PIER/ESI transmission R&D planning
 - Linda Kelly and Jamie Patterson are the CEC project managers

Project Approach



Important Issues to Keep in Mind

- This project is only one input to the development of PIER/ESI's Transmission R&D plan
 - It is *NOT* a proposal for PIER/ESI's transmission R&D plan
- List of transmission technologies is limited by CEC
 - PIER ESI has conducted/is conducting parallel R&D planning activities for closely related technologies that are managed separately under Distributed Energy Resources (M. Rawson) and Demand Response (R. Hofmann)
- Scenario analysis is a *tool* for R&D planning
 - NOT predictions
 - NOT policy preferences
- Identification of public interest transmission R&D priorities is based on criteria and considerations provided by PIER ESI staff

Transmission Technologies Considered - 1

Real Time Grid/Asset Monitoring and Analysis Tools

- Dynamic Transmission Line and Transformer Monitoring and Systems

- Real-Time Direct System-State Monitors and Wide Area Measurement Systems

- Real-Time Grid Operations and Performance Monitoring Tools

- Grid Analysis Tools

- Communication Systems for T&D Systems

Transmission Power-Flow Control, including Energy Storage

- Flexible AC Transmission Systems (FACTS)

- Energy Storage (not diurnal)

Market Design, Monitoring, and Analysis Tools

Transmission Expansion Planning Tools and Approaches

Public Health, Safety, and Environmental Issues

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Transmission Technologies Considered - 2

Transmission Hardware

Ultra-High Voltage AC

High-Voltage DC

Underground Cables

Transmission Tower Design Tools

Advanced Composite Conductors

Standardized, Modular Transformers

Advanced Transmission Hardware

High-Temperature Super-Conducting Technologies

Polyphase Transmission Line Configurations

Advanced Real-Time Control Approaches

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PIER's R&D Criteria and Considerations

Criteria for PIER R&D

- Improves the quality of life for California citizens
- Improves the efficiency and reliability of the electricity transmission system
- Advances science and technology
- *Is unlikely to be adequately provided by the competitive or regulated research sectors*

PIER's R&D Criteria and Considerations

Considerations for PIER R&D

- Development risk is too high and/or development time horizon is too long for the private sector
- Technology development costs are too high, but CA public benefits payoff is substantial
- Market and regulatory barriers/uncertainty would inhibit successful implementation; CA public benefits payoff is substantial; and there is a reasonable path to mitigate barriers/uncertainty

Four Transmission R&D Planning Scenarios

- Continuation of Current Trends - “Muddling Through”
- State-Mandated Solutions
- Greater Regional Coordination
- Emergence of Local Solutions

Period of Analysis is 5 years - 2003-2007

Remember: scenarios are not predictions and
are not expressions of policy preferences

Continuation of Current Trends - 1

- Extended period of financial distress, institutional conflict, and lack of resolution as result of CA “electricity crisis”
- Continued strife between FERC and State over structure and organization of wholesale electricity markets
- Impending supply shortfalls throughout West due to financial distress of merchant generators
- Demand growth slowed by chilling effect of uncertainties in state’s economy, but also due in part to concerns regarding the long-term health of power sector
- Path 15 upgrades delayed – rolling blackouts

Continuation of Current Trends - 2

- Continued ownership of transmission assets by financially challenged IOUs
- Continued operation of transmission assets by CAISO – keeping the lights on at any cost
- Poor incentives for transmission system investment
- Transmission planning dominated by generation interconnection requests (that fail to materialize)
- MD02 not in place; price caps routinely invoked as “circuit breaker” on run-away markets
- Absence of meaningful penalties for failure to comply with reliability rules of the road

State-Mandated Solutions - 1

- Deference by FERC to State over structure and organization of CA wholesale electricity markets
- Aggressive state-led planning for new generation (including renewables), transmission and demand-side resources
- Streamlined and tightly coordinated siting and permitting processes
- State backs investments in in-state generation (e.g., CPUC directs IOUs to sign long-term contracts)
- In-state supply-demand imbalance is reduced, but imports still required to meet load
- Demand growth continues at 90's rate (2% year)

State-Mandated Solutions - 2

- Continued ownership of transmission assets by (now) financially healthy IOUs
- Continued operation of transmission assets by CAISO – still keeping the lights on at any cost
- Improved returns and regulatory guarantees for transmission system investment
- State-led integrated planning processes encompass transmission planning as key element of resource portfolio – priority is on reliability
- MD02 fully in place; yet coordination w/in region still developing
- Still, an absence of meaningful penalties for failure to comply with reliability rules of the road

Greater Regional Coordination - 1

- A unified market design for the West is implemented through the creation of an integrated set of 3 large RTPs
- Regional resource planning is initiated, yet mechanisms for coordination/governance still under-development
- Stable markets lead to a healthier climate for private investment in generation; LMP effective in directing investment to areas most in need
- Regional supply-demand balance restoring; inter-regional trade is significant; demand growth continues at 90's rates
- Stable opportunities for demand-side participation in wholesale markets

Greater Regional Coordination - 2

- Continued ownership of transmission assets by financially healthy IOUs/operation by CAISO (= RTP)
- Siting and permitting processes are coordinated with regional planning entities
- Regional consensus is achieved on transmission expansion by fairly aligning allocation of costs and benefits of transmission investments; devil remains in the details
- Improved returns and increased regulatory guarantees for transmission system investment (PBR for IOUs)
- Enforcement of meaningful penalties for failure to comply with reliability rules of the road

Emergence of Local Solutions - 1

- Local governments and organizations assume a greater role for energy planning – municipalization occurs
- Increased reliance on smaller-scale distributed generation, renewables, and energy efficiency; regulatory (e.g., utility) barriers to DER successfully lowered
- Assumes cost breakthroughs for advanced DER and interconnection technologies
- Demand growth, at least as seen from the bulk power system, is reduced somewhat
- Public opposition blocks siting of new in-state generation and transmission; yet, there is continued need for imports of electricity from surrounding regions

Emergence of Local Solutions - 2

This scenario may be consistent with aspects of all three of the other scenarios

Principle effect on bulk power system is reduction in demands that must be met through central station generation and high voltage transmission

Transmission R&D Assessment

Continuation of Current Trends

Supply-demand imbalances increase risks of blackouts

Markets are dysfunctional – continuing price spikes

Real-time reliability management is a significant on-going challenge for grid operator

No new intra- or inter-regional transmission line construction

IOUs experience severe financial pressures – no funds available for R&D

CAISO is an operational entity with no mandate for R&D

Transmission R&D Priorities

Continuation of Current Trends

Highest priorities

Real-time grid/asset monitoring and analysis tools

Advance real time control approaches

Market design, monitoring, and analysis tools

Lower priorities

Transmission hardware and power flow control technologies, including energy storage

Transmission expansion planning tools and approaches

Public health, safety, and environmental issues

Transmission R&D Assessment

State-Mandated Solutions

Supply-demand imbalances less severe; CA still dependent on imports

“Seams” persist between CAISO and rest of West

Real-time reliability management is still a significant challenge for grid operators

No new inter-regional transmission line construction; limited in-state construction

IOUs, again, able to support internally funded R&D but limited to topics related to incremental new construction, not regional coordination

CAISO remains an operational entity

Transmission R&D Priorities

State-Mandated Solutions

Highest priorities

Real time grid monitoring and analysis tools for reliability management

Advanced real time control approaches

Market design, monitoring, and analysis tools

Transmission expansion planning tools and approaches

Lower priorities (*co-sponsor industry-led)

Power flow control technologies, including energy storage*

Advanced transmission hardware technologies*

Public health, safety, and environmental issues

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Transmission R&D Assessment

Greater Regional Coordination

Regional supply-demand imbalances are somewhat addressed through improving coordination w/in region and by more stable financial climate for investment

Markets are integrated and more consistent throughout the West

Region-wide real-time reliability management is technically challenging, but forum for institutional coordination has been established

Coordinated, inter-regional transmission line construction is being integrated with region-wide resource planning; emerging merchant transmission projects

IOUs able to support internally funded R&D

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Transmission R&D Priorities

Greater Regional Coordination

Highest priorities (*co-sponsor industry-led)

Real time grid monitoring and analysis tools for reliability management*

Advanced real time control approaches*

Market design, monitoring, and analysis tools*

Transmission expansion planning tools and approaches*

Lower priorities (*co-sponsor industry-led)

Transmission power flow control technologies, including energy storage*

Advanced transmission hardware*

Public health, safety, and environmental issues

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Transmission R&D Assessment

Emergence of Local Solutions

As stated, this scenario may be compatible with any one of the previous three scenarios

Net effect is that reliance on transmission system is reduced overall

Greater role by a multitude of active sources w/in distribution grids – “two-way” flows of power in a system designed for “one-way” flows

Transmission R&D Priorities

Emergence of Local Solutions

Highest priorities

Same as Scenario 1, with increased focus on:

Real time monitoring and tools applied at distribution system,
including power quality

Integrated transmission and distribution system planning

[PIER Distributed Energy Resources – system integration]

Lower priorities

Same as Scenario 1, with increased focus on:

Local public health, safety, and environmental issues

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Discussion Questions

1. Do the scenarios, as described, provide an adequate basis upon which to assess possible transmission futures and their implications for R&D?
2. Is the assessment of the transmission R&D needs for each scenario accurate and complete?
3. Is the assessment of the interests and capabilities of various market players and stakeholders consistent with the scenario descriptions?
4. Are the identified priorities for PIER Energy Systems Integration (ESI) transmission R&D consistent with ESI's criteria for PIER funded R&D?
5. What additional factors should the Energy Commission consider in developing a portfolio of PIER ESI transmission R&D activities?